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IMPORTANCE AND CAUSES OF TIMBER MORTALITY IN EASTERN MONTANA FORESTS

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Every year in Eastern Montana more green timber dies because of such natural agents as wind, insects, fire, disease, and winterkill than is cut for all purposes. That is the estimate of the Forest Survey, based on data collected on 2713 1/5-acre sample plots distributed throughout the 9.3 million acres of commercial forest land in Montana, east of the Continental Divide. The average annual mortality loss for the period 1944-1948 is estimated to be 67 million board feet in saw-timber-size trees, as compared to a cutting drain of 50 million board feet including woods and mill waste in 1948. The excess of mortality is more striking when the cubic-foot volume of all timber over 5.0 inches in diameter is considered. Here mortality is 49 percent greater than cutting drain. Table 1 compares mortality with cutting drain by species.

Table 1. Comparison of commodity drain and average annual mortality. 1948

Species	All timber 1/		Saw timber	
	Mortality	Drain 2/	Mortality	Drain 2/
	Thousand cubic feet		Thousand board feet International 1/4" rule	
Ponderosa pine	1,804	2,353	8,404	8,171
Douglas-fir	4,696	3,902	18,157	19,092
Lodgepole pine	10,791	5,179	30,060	12,594
Other	3,948	3,045	10,777	10,050
Total	21,239	14,479	67,398	49,907

1/ The term "all timber" applies to all trees on commercial forest land which are 5.0 inches d.b.h. and larger.

2/ Includes commodity cutting and woods and mill waste attributable to such cutting.

Only in Douglas-fir saw timber and ponderosa pine all timber does the cutting drain exceed mortality. Lodgepole pine, which includes white bark and limber pine in this report, shows mortality losses more than twice the cutting drain. Increased cutting of lodgepole pine for pulpwood in the future may change this picture.

Mortality losses do not occur at a uniform rate year after year, nor are they evenly distributed throughout the forest. Such losses are sporadic in both time and area distribution. For example, the beetle-killed forests of Beaverhead County bear evidence of the heavy loss experienced there in the late twenties and early thirties. During the severe drought of the thirties, the loss of ponderosa pine in the extreme eastern portion of the state is believed to have been accelerated. In later years there have been localized areas of heavy loss due to windstorms and winterkill. These "flare-ups" of mortality make an estimate of annual loss difficult. A fairly reliable estimate can only be arrived at by an average of several years from a large area. The data in table 2 are based on such an average.

Table 2. Average annual mortality losses by species and type. 1944-1948

Forest type	Species					Per acre
	Ponderosa pine	Douglas-fir	Lodgepole pine	Other	Total	
	ALL TIMBER					
	Thousand cubic feet					Cu.ft.
Ponderosa pine	1263	38	--	--	1,301	1.1
Douglas-fir	201	3,795	578	411	4,985	2.9
Lodgepole pine	--	687	9,696	1,822	12,205	4.9
Other	340	176	517	1,715	2,748	1.9
All types	1804	4,696	10,791	3,948	21,239	3.1
	SAW TIMBER					
	Thousand board feet - International 1/4" rule					Bd.ft.
Ponderosa pine	5766	--	--	--	5,766	4.9
Douglas-fir	979	14,251	1,918	869	18,017	10.5
Lodgepole pine	--	3,156	26,119	4,497	33,772	13.5
Other	1659	750	2,023	5,411	9,843	6.9
All types	8404	18,157	30,060	10,777	67,398	9.8

Losses of lodgepole pine form a disproportionately large share of the board-foot mortality as compared to board-foot growing stock. Douglas-fir, on the other hand, represents the reverse situation (table 3). A partial explanation of this is that lodgepole pine trees reaching sawtimber size are much nearer maturity than are similar trees of either ponderosa pine or Douglas-fir. The greater density of lodgepole pine stands is also a contributing factor.

Table 3. Proportion of saw-timber growing stock and mortality by species

Species	Saw timber	
	Growing stock	Mortality
	-Percent-	
Ponderosa pine	10	12
Douglas-fir	39	27
Lodgepole pine	31	45
Other	20	16
	100	100

In making calculations of future cut based on growth, the forest manager must take into consideration the volume he expects to lose as mortality. By deducting mortality from gross growth he determines net growth which is the basic figure for computing future harvests. In Eastern Montana fully one fifth of the total board-foot growth of saw-timber trees and one eighth of the cubic-foot growth of all trees are canceled out by mortality losses (table 4). Lodgepole pine suffers the greatest reduction of effective growth due to mortality of any species. This amounts to canceling nearly one third of the total board-foot growth of this species. To provide an annual net growth of 1000 board feet the forest must actually produce nearly 1500 board feet of wood. Only one other species in the area - ponderosa pine - approaches lodgepole pine in the percent of loss of effective growth.

Table 4. Comparison of growth and mortality

Species	Total growth	Mortality	Net growth	Percent of total growth lost to mortality
	ALL TIMBER			
	Thousand cubic feet			Percent
Ponderosa pine	13,992	1,804	12,188	13
Douglas-fir	45,603	4,696	40,907	10
Lodgepole pine	69,388	10,791	58,597	16
Other	36,256	3,948	32,308	11
All types	165,239	21,239	144,000	13
	SAW TIMBER			
	Thousand board feet - International 1/4" rule			
Ponderosa pine	29,509	8,404	21,105	28
Douglas-fir	113,973	18,157	95,816	16
Lodgepole pine	91,580	30,060	61,520	33
Other	92,336	10,777	81,559	12
All types	327,398	67,398	260,000	21

The causes of mortality are varied. Some of the principal ones are insects, disease, windthrow, winterkill, fire, and suppression. The loss of vigor that goes with maturity and suppression during the growth of a stand is an invitation to some of these agents, particularly insects and disease. Frequently the exact cause of death is difficult to determine. There were definite indications of cause for only 45 percent of the mortality losses in Eastern Montana. The 55 percent which could not be classified probably resulted from numerous causes, including some of those listed in the classified group of the tabulation below. Not to be overlooked, however, is the fact that some and possibly a large part of the unclassified trees died from old age and did not show evidence as to cause. The loss by causes as determined by the survey was as follows:

Classified causes	Percent	
Insects	19	
Wind	11	
Winterkill	7	
Animal (porcupine)	5	
Lightning, disease, fire, and snow	3	45
Unclassified		55
		100

The proportion of total loss attributable to any one cause varies from one period to another. For example, the amount of winterkill seems high. A survey covering some other 5-year period might show practically no loss to this factor. Insect epidemics, particularly, may break out and cause losses from this source to rise sharply. Biologists believe that porcupine populations are cyclical and as the number of porcupines rises so does the number of trees killed. Violent local windstorms in recent years have destroyed much timber. One such storm on the Beaverhead National Forest in the summer of 1948 is estimated to have killed 6 million cubic feet of timber. Drought losses are believed to have been higher during the mid-thirties.

Mortality losses in Eastern Montana can be expected to decrease as utilization increases and more intensive management becomes economically feasible. If the saw-timber material dying annually could be fully utilized it would be sufficient to support a forest industry one-third larger than that existing in 1948. In the case of lodgepole pine, full utilization of dying material coupled with the annual cut of green timber could mean an industry more than three times as large as in 1948. This is particularly important in view of the increasing demand for lodgepole pine as pulpwood. Utilization of this annual loss can increase the present production without eating into the growing stock, the basic source of future harvests.